

Ambient Air Monitoring

NASA Satellite Data

Air Quality Models

Identifying

Evaluating



Developing

Delivering



Part IA - CDC



Public Health Air Surveillance Evaluation

A Multi-Agency, Multi-Discipline Collaboration

Wisconsin



• Routinely Available Air Characterization Data

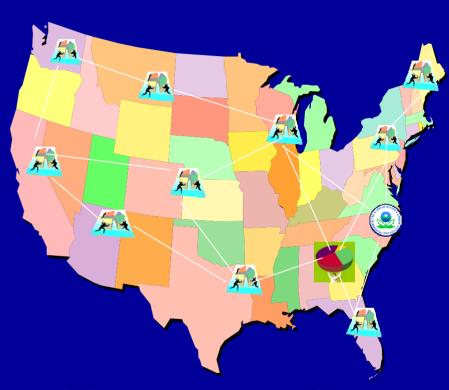
- Ozone & Particulate Matter
- Compatible w/Hosp. Disc. & ED
 Data
 - Asthma
 - Cardiovascular Disease

How to Guide (Cookbook)

- Case Definitions
- Other Risk Factors
- Confounders/Covariates
- Analysis Software

Lessons Learned

- Scientific & Technical
- Multi-Agency, Multi-Disciplined Collaboration



VISION – Data & Results Comparable



Background



EPHT Hazard Data Determined by:

- Health Effect of Interest
- Characteristics of Health Effect Data
- Type Exposure (Acute vs Chronic)
- Desired Public Health Action







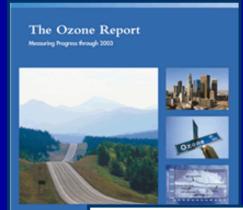




Identifying Data Sets for EPHT

Desirable Characteristics:

- Ongoing, Systematic Collection
- Available for Most States
- Std Collection/Reporting
- QA/QC Procedures
- Temporal & Spatial Variables
- Fine Resolution of Data
- Timely Availability
- Related to Human Exposures



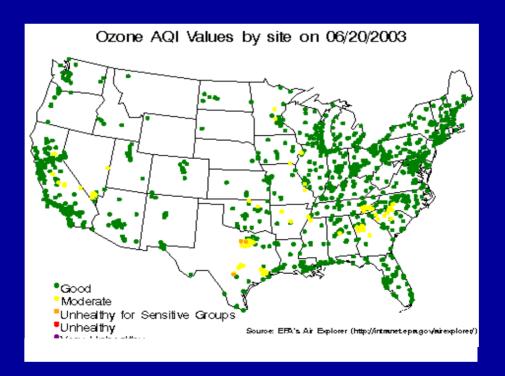




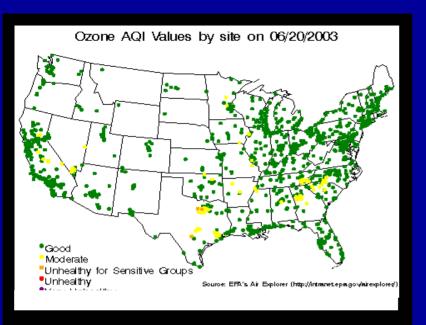


Ozone & PM Air Monitoring Data

- Desirable Characteristics
- Significant Limitations
 - Spatial Gaps
 - Temporal Gap









Perception





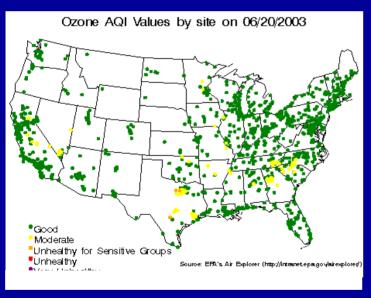
Reality

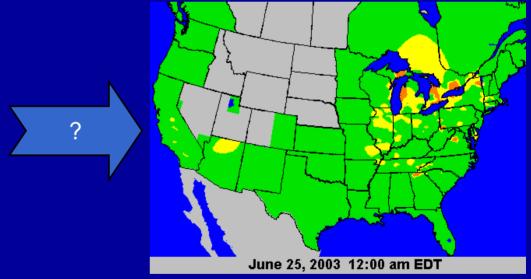




EPA PARTICIPATION IN PHASE

Question: Best Method for Generating Air Data Useful for Assessing the Health Status of All Populations?









STATE PARTICIPATION

Criteria:

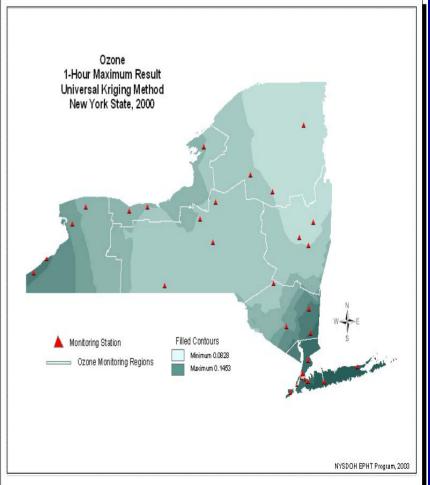
- Air Project in Work Plan
- Initial Measures Identified
- Northeastern State
- At Least 1 Part A State
- Request for CDC Assistance



New York State Request

Interpolation Methods?



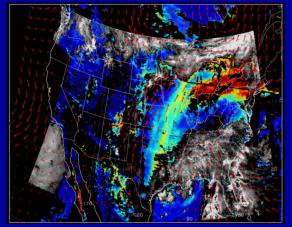




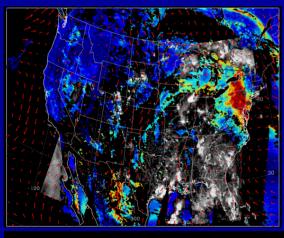
Wisconsin Request

Satellite Data?

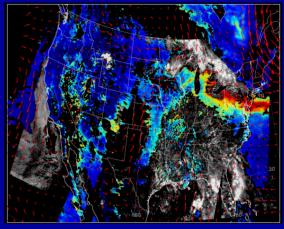
June 23 June 24



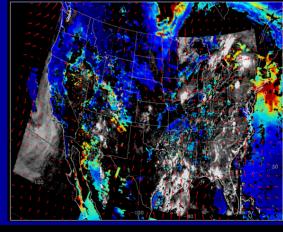
June 25



MODIS Sensor aboard the Terra Satellite Captures a PM **Transport Event** in June 2002. High Aerosol Optical Depth over upper mid-West moves East, then out to the Atlantic Ocean.



June 26







Maine Question





Part IB - EPA



PHASE Panel Discussion: Characterizing Air Quality for Environmental Public Health Tracking

CDC's Second Annual
Environmental Public Health
Tracking Conference
April 22, 2005
Timothy Watkins
US EPA's Office of Research and Development

Overview of Presentation

Brief overview of EPA's perspective

What air quality data are available?

How do these data compare?





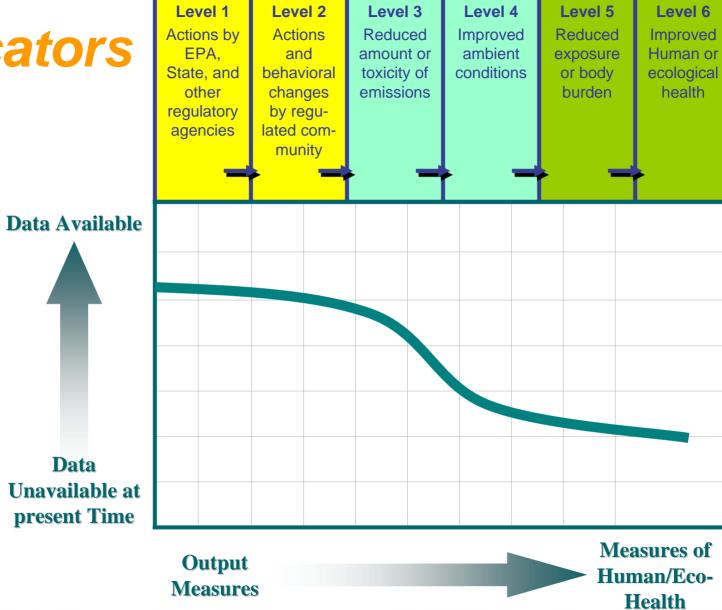
EPA's Mission

 "To protect human health and to safeguard the natural environment — air, water, and land — upon which life depends."

How do we measure our effectiveness?

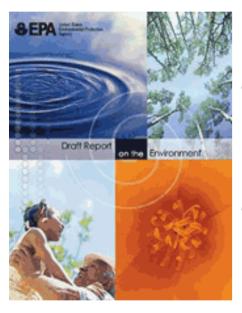


Indicators





Questions remain about the impact of EPA Activities on Public Health



- Detroit News (May 7, 2000)
 - An evaluation of EPA's first 30 years
 - "Air and Water are cleaner, but health gains unclear"
- EPA Draft Report on the Environment
 - "There is a need for measures to compare actual and predicted human health and ecological effects related to exposure to air pollutants."
- National Research Council
 - Recommendation: "Develop and implement a system to assess and monitor human health and welfare effects through the identification of indicators capable of characterizing and tracking the effects of air pollutants"
- Health Effects Institute
 - RFA "Measuring the Health Impact of Actions Taken to Improve Air Quality"



Sources of Air Quality Characterization Data

Ambient Air Monitoring

Air Quality Modeling

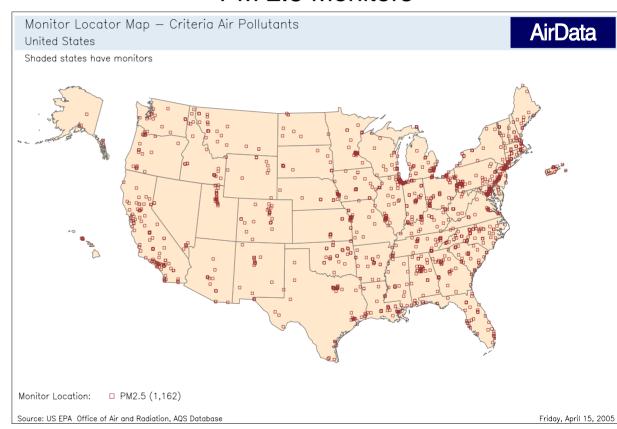
Satellite Data



Ambient Air Monitoring

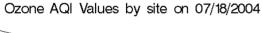
PM 2.5 Monitors

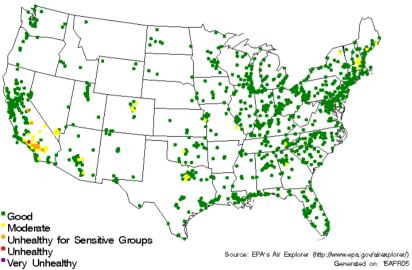
- "True" measure of air quality
- Spatial gaps rural areas have few sites
- Temporal quality varies hourly to weekly
- Routinely available information



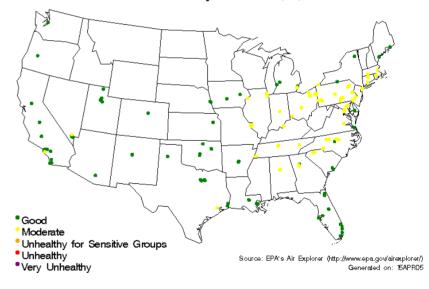


Example Ozone and PM Ambient Monitoring Data





PM2.5 AQI Values by site on 07/18/2004

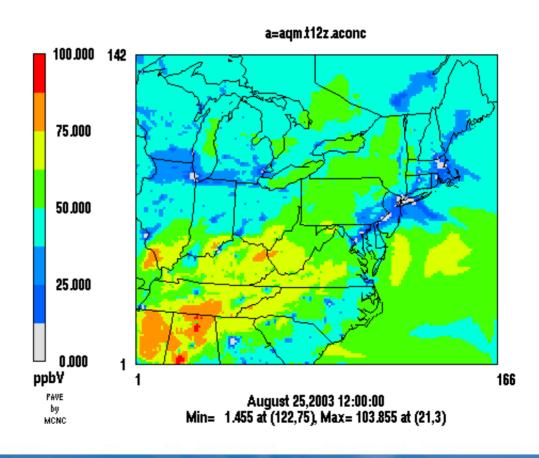




Air Quality Modeling

Layer 1 O3a

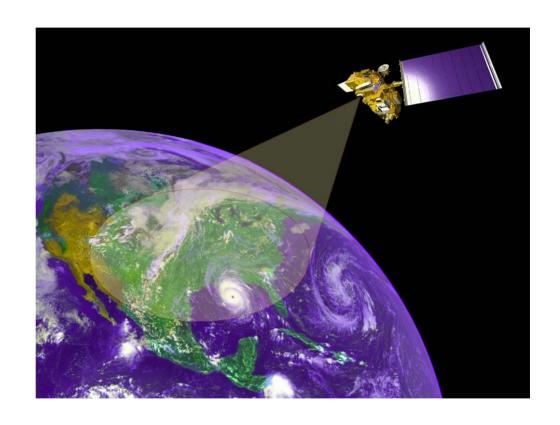
- Estimate of air quality
- Good spatial and temporal coverage
- Air Quality Forecasting
 - Emerging source of routine data





Satellite Data

- Emerging source of data
- Spatial and Temporal Gaps
 - Cloud cover
 - Reflective surfaces
- Potential new source of routinely available data
 - Additional work needed





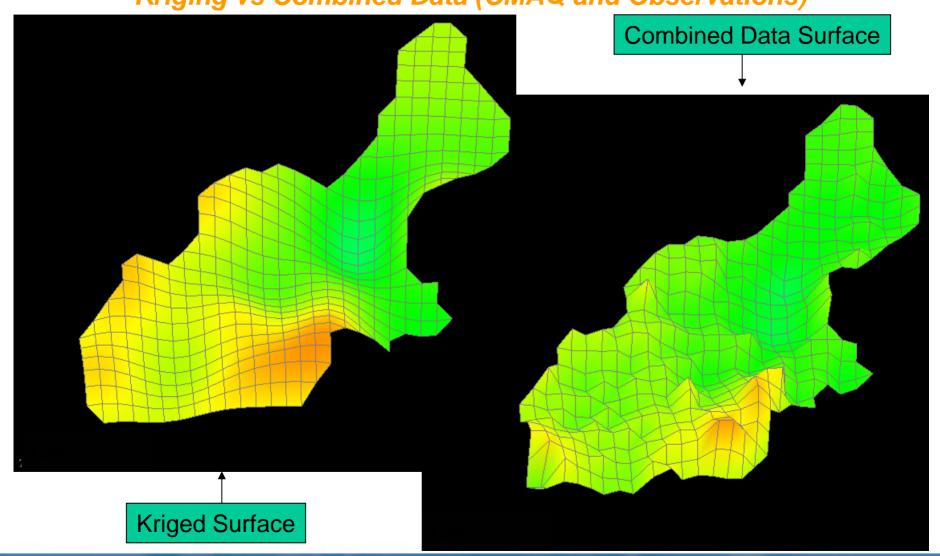
The Role of Statistics

- Statistical techniques can be used to fill in the spatial and temporal monitoring gaps
- Statistical techniques have mostly relied solely on ambient monitors
 - We statistically interpolated with "Kriging"
- New statistical techniques "combine" ambient monitoring and emerging sources of data (e.g., satellite, modeling)
 - Capitalize on the strengths of each data source while minimizing the weaknesses
 - Provide a sense of uncertainty
 - We used Hierarchical Baysian (HB) technique



Combining Air Quality Data

July 21, 2001 Ozone Levels: Kriging vs Combined Data (CMAQ and Observations)





Ambient vs. Personal Exposure

- Methods estimate ambient concentrations, but . . .
- People experience health impacts from the air they breathe (i.e., their personal exposure)
- How do the outputs from the various air quality characterization methods relate to personal exposure?



Personal Monitor



Initial Observations On Air Quality Data

Air Quality Data

- Daily estimates are provided for type of data for 2001.
 - Particulate matter2.5 (daily mean) many temporally interpolated day
 - Ozone (daily 8 hour maximum) most in the ozone season
- Different scales (depending on data type)
 - 4, 12, 36 KM grids



Preliminary Qualitative Comparison of Air Quality Characterization Data

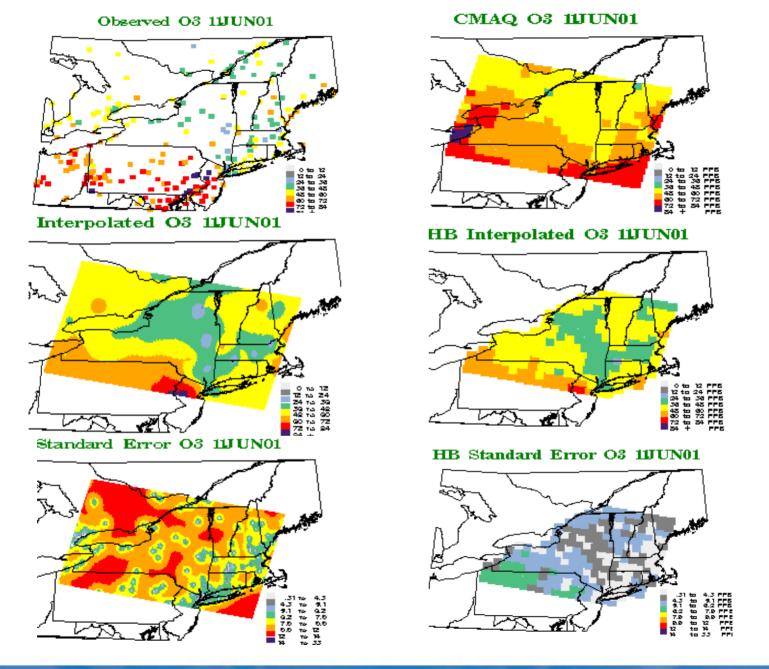
Data Type Criteria	Ambient data	CMAQ	Statistically Interpolated Surface	Hierarchical Baysian Surface
Ease of delivery	Н	Н	M	M
Spatial coverage	L	M	Н	Н
Temporal coverage	M	Н	M+	М-Н
Match ambient data	н	М	М-Н	М-Н
Resource Requirements	L	Н	M	Н
Strength of relationship to exposure and health data	Unknown	Unknown	Unknown	Unknown



Comparative Maps:

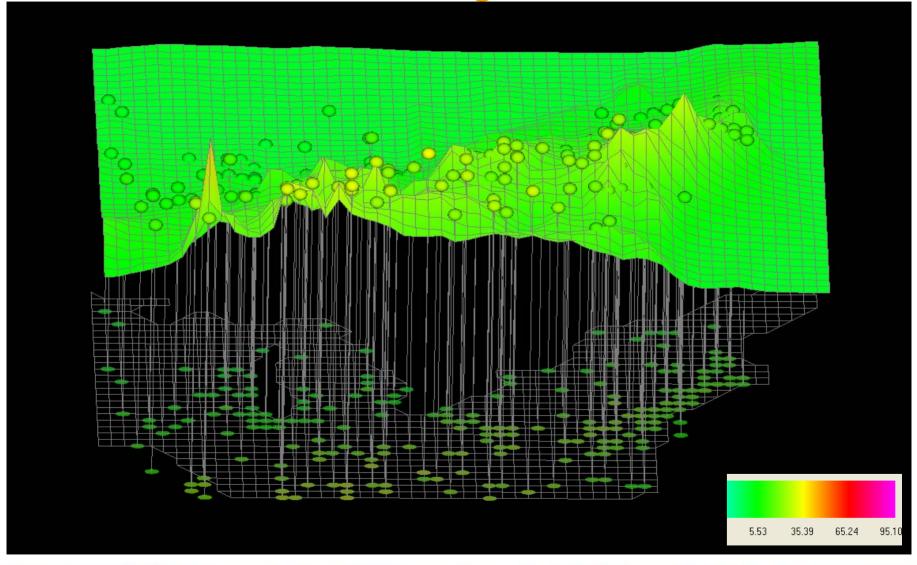
- Maps used to illustrate ...
 - Spatial differences in spatial resolution/patterns
 - Difference in "error" estimates
 - "Odd" results
 - Improvement seen by combining measured and modeled data





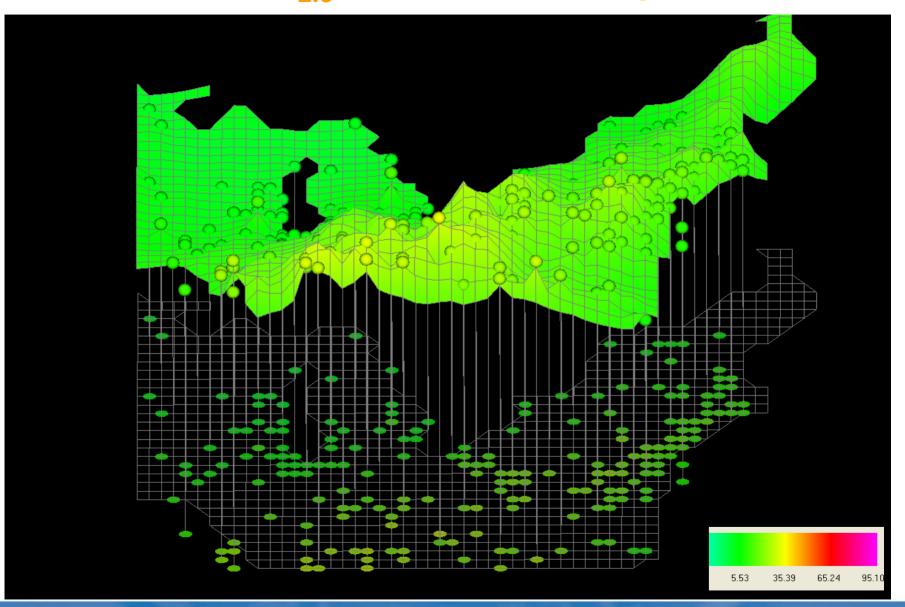


Daily PM_{2.5} Concentration (ug/m³) Sept. 12, 2001 EPA FRM Monitoring Data and CMAQ



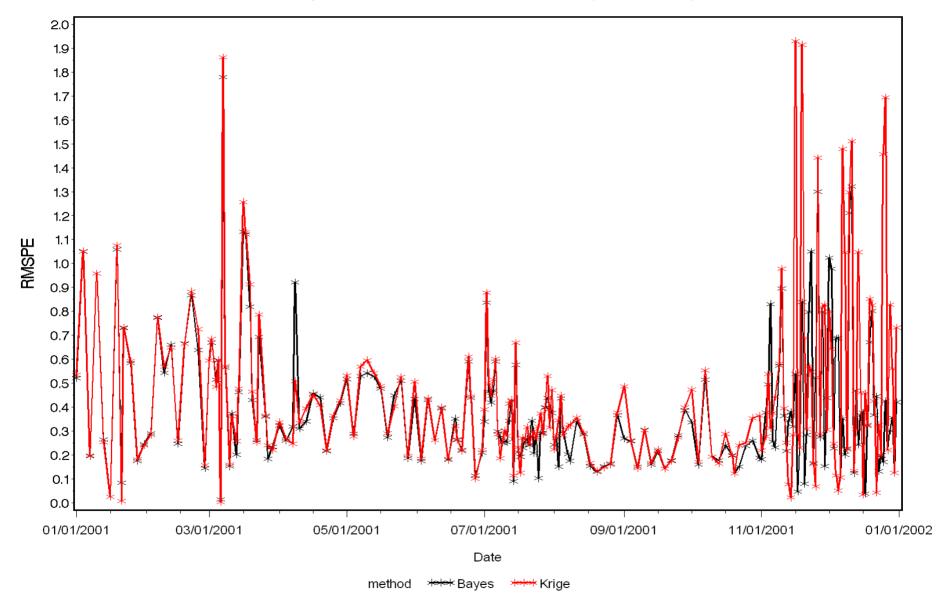


Combined PM_{2.5} (ug/m³) Surface, Sept. 12, 2001





Root Mean Squared Prediction Error (RMSPE) vs. Date





Summary





- EPA is seeking better ways to measure the success of its programs.
 - Demonstrate impact on public health
- Environmental Public Health Tracking (EPHT) is seeking compatible air quality data to inform public health actions.
- There are new possibilities for improving the way we characterize air quality.
- These new approaches may improve our ability to understand relationships between air quality and public health.
- The PHASE Project is evaluating these new approaches and their potential application to EPHT air issues.



Acknowledgements

- Fred Dimmick, EPA ORD
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- Bill Cox, EPA OAR
- Ellen Baldridge, EPA OAR



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Part II – Question & Answer



What Health Effects?

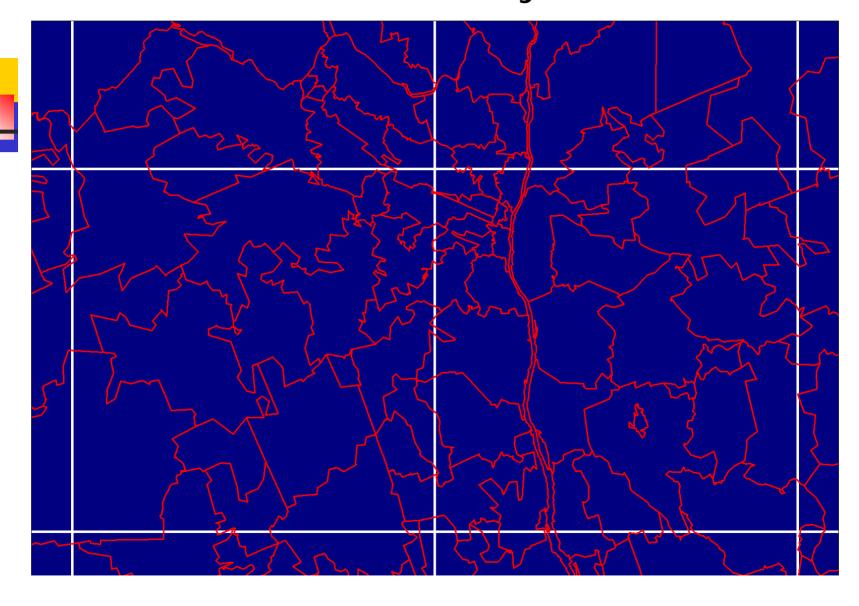
- Asthma
 - Biological Plausibility
 - Association Research Literature
 - Significant Morbidity Children
 - Priority in all 3 States

Cardiovascular Disease

How did you link data?

- NYS
 - Geocoded Residential Address
 - GIS Assigned to Grid
 - Ungeocodable Protocol
- ME & WI
 - Zip Code Level Data
 - Population Weighted Centroids
- Evaluating Impacts of Scale
 - 36, 12, 4km

ZIP Codes and Air Quality Grids

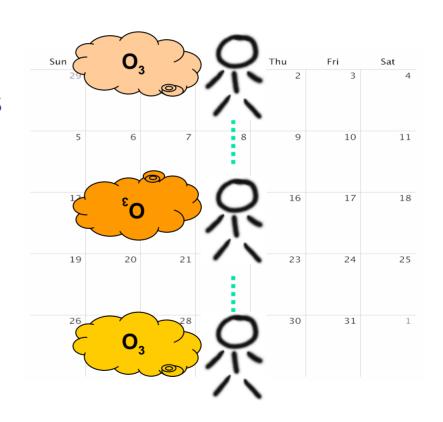


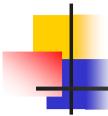


How did you assess the association?

Case-crossover analysis

Case-crossover analysis compares exposure before case event to exposure at referent times, in the same individuals.





How did you assess the association?

Case-crossover: advantages

- only need case information
- matched design
- exposure assignment to individual
- can study interactions
- simple to use
- drawbacks? sure...

What are you after?

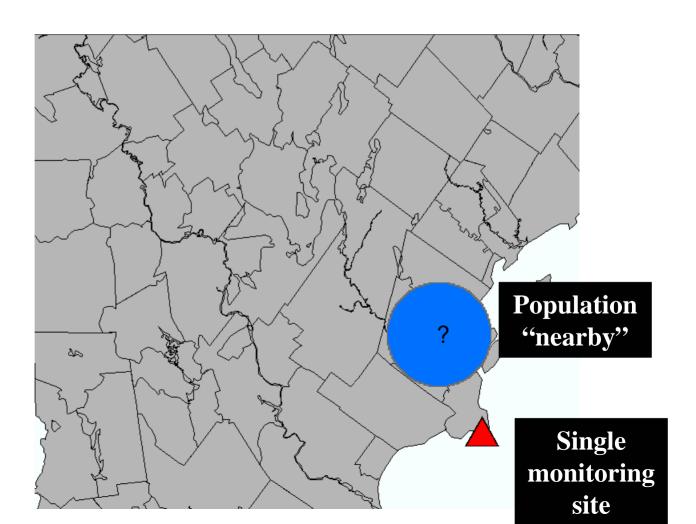
It's Surveillance!

- not about establishing cause-effect
- tracking association over time and place
- What for?
 - check on interventions
 - check on regulations
 - look for vulnerable subpopulations

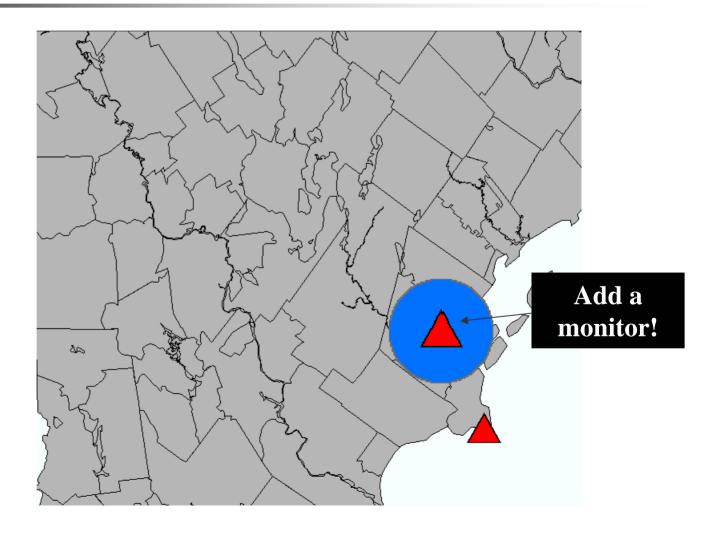


How were you doing this before PHASE?

Pre-PHASE Plan (Maine)



Maine



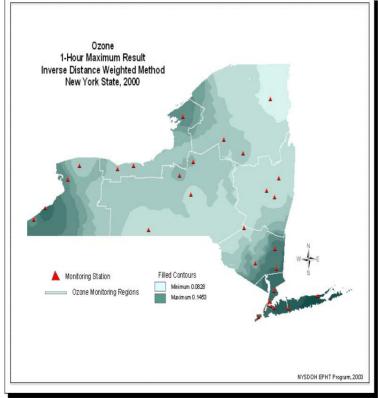
NYS

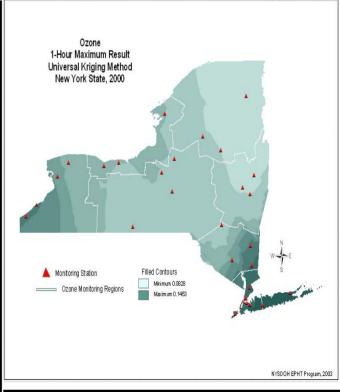


IDW

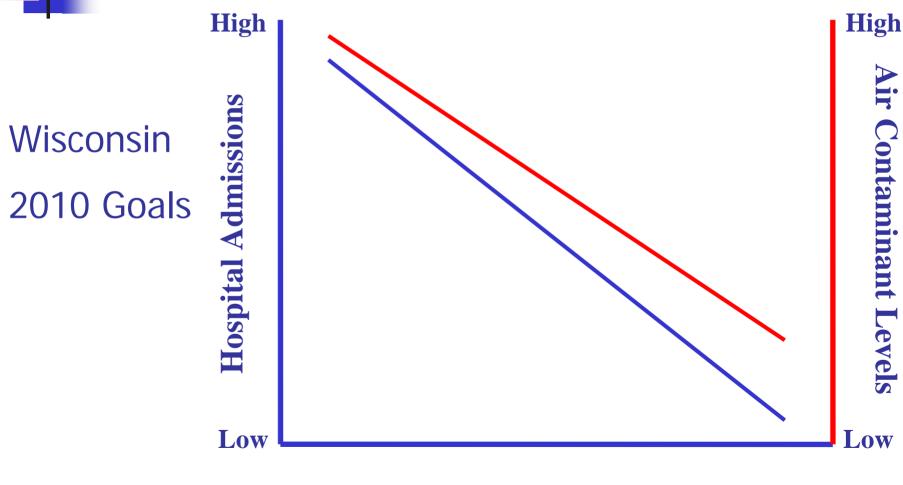
Kriging









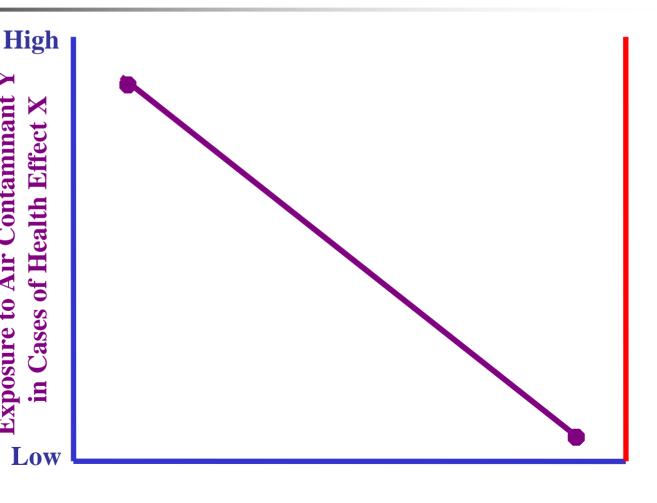




Post-PHASE?

Exposure to Air Contaminant Y

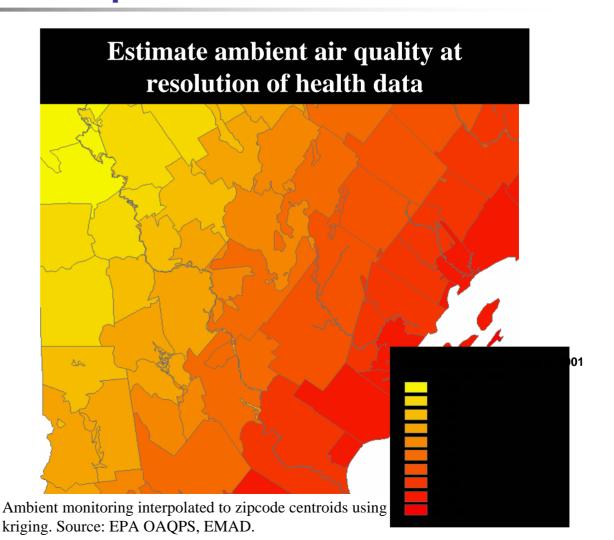
Wisconsin 2010 Goals



2000 2010

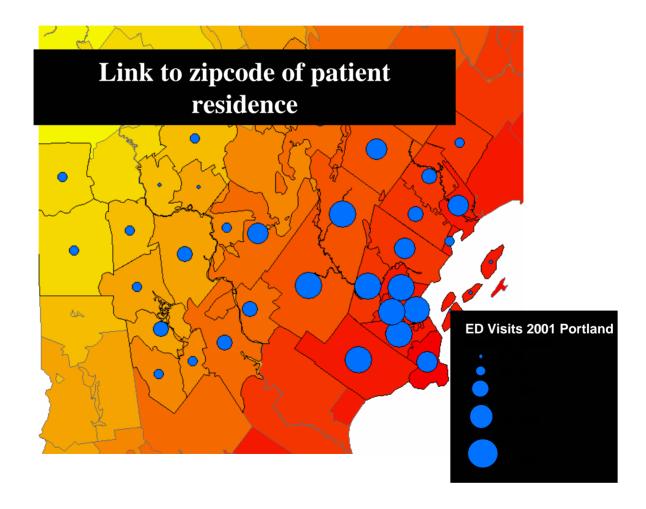
post-PHASE plan

Maine



post-PHASE plan

Maine



What can you do now?

- Single Indicator
- Compare Across States
- Increased Credibility
- Assess Rural Communities
- Focus Resources
 - Health Data
 - Analysis Methods

Issue - Confidentiality of Health Data

Obstacles & Opportunities

- Analytical Challenges
 - 4 sets air char. data & monitoring data
 - 4 resolutions air data
 - Several lag times
 - Different referent periods
 - Cultural Barrier



Obstacles & Opportunities

- MOU
- Data Sharing Agreements
- Building Trust
- Snowballing Efforts
- Expectations

Post-PHASE

- Standardized Linkage Methods
- Indicator Development & Utilization
- Common Analysis Method
- Multi-state Comparisons

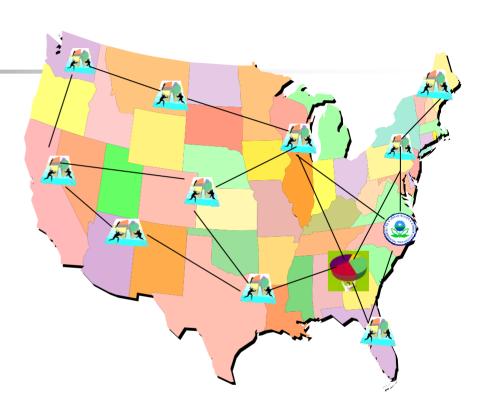


Obstacles & Opportunities - EPA

- Developing new air quality characterization techniques
- Skepticism about air quality models
- Understanding strengths and limitations of health data
- Educating health departments about air quality data
- Internal coordination among different expertise (monitoring, models, and statistics)

Sustainability

- Routinely Available Air Characterization Data
 - Ozone & Particulate Matter
 - Compatible w/Hosp. Disc. & ED
 Data
 - Asthma
 - Cardiovascular Disease
- How to Guide (Cookbook)
 - Case Definitions
 - Other Risk Factors
 - Confounders/Covariates
 - Analysis Software



VISION - Data & Results Comparable

Sustainability

- Resources to generate air quality data
 - Depends greatly on method
- Supporting EPA Interests
 - Tracking health endpoints of interest
 - Providing information to measure and evaluate effectiveness of policies/regulations
- Development of IT tools to facilitate data transfer/exchange